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Long-term effects of selective logging in tropical rain forests in Guyana: Consequences for future timber yields and tree diversity

Eric J.M.M. Arets

Introduction

Because timber is an important source of income and only a small area of Guyana's forest can be effectively protected, selectively logged forests will play an important role in the conservation of biodiversity in Guyana. Forest management should result in sustained timber yields over long periods of time to provide lasting revenues and to secure livelihoods, while also biodiversity should be conserved as much as possible. To be able to define criteria for sustainable forest management, information on the long-term effects of logging is needed.


Selectively logged forest

The **aim** of this study was to evaluate the sustainability of alternative forest management scenarios for both future timber yields and biodiversity conservation.

Methods

A field study was carried out in logged and non-logged forests in Guyana. Additionally a simulation model (SYMFOR) was developed to evaluate the long term effects of different management scenarios. This population dynamics model simulates growth, mortality and recruitment of trees and makes projections of forest composition and available hardwood.

Management scenarios with different felling cycles (C, in years), minimum felling diameter (D, in cm) and harvesting intensities (I, in trees ha^{-1}) were evaluated. Scenarios are coded as follows: C-D-I, e.g. C25-D35-I12. In Guyana the current statutory limit for felling cycle is 25 years and the minimum felling diameter is 35 cm.

Results

- Small long-term effect of selective logging on relative composition of tree functional groups, but on the short term temporarily increased abundance of pioneers.
- Six years after reduced impact logging diversity of tree saplings had increased with increasing disturbance (Figure 1).
- Projected time needed for full recovery of commercial wood volume exceeds 110 years for logging scenarios with harvest intensities ≥ 8 trees ha^{-1}. See also Figure 2.
- Climax canopy trees need > 80 years to recover abundances after logging with harvest intensities ≥ 4 trees ha^{-1}.
- Trade-off between productivity and sustainability of scenarios (Table 1).

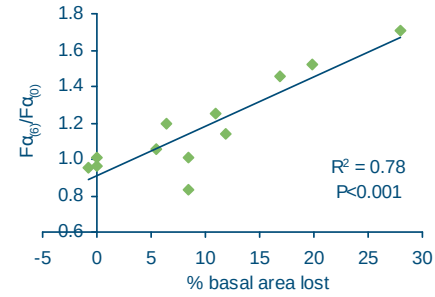

Figure 1. Effect of disturbance on α-diversity of tree saplings (diameter 2 to 5 cm) in logged sample plots in central Guyana. $Fα_{(0)}$ is Fisher's α before logging and $Fα_{(6)}$ six years after logging.

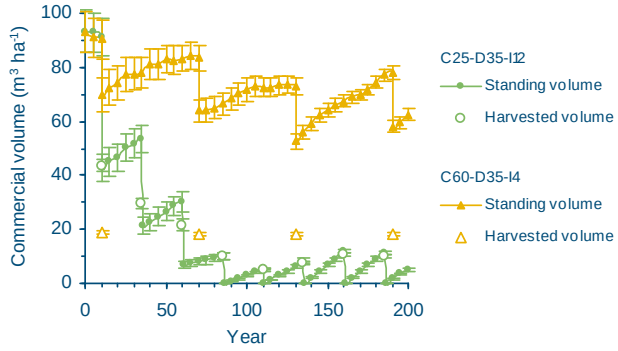

Figure 2. Projected standing and harvested commercial wood volumes (m^3 ha^{-1}) for logging scenarios with lowest (C60-D35-I4) and highest (C25-D35-I12) logging intensities.

Table 1. Projected yields and changes in tree composition for the first three harvesting events. Indicators of productivity are: mean total yield and average annual yield of the first three cycles. Indicators of sustainability are: % first yield (yield as percentage of the yield of the first harvest), and changes in functional group composition (*G* -statistic) just before the third harvest. Most productive or most sustainable ranks (1) are underlined. Values are averages ± s.e. for 30 repetitions.

	Volume	% first yield			Total yield		Av. annual yield		Composition	
Logevent:	1	2	3	2 & 3	∑ 3 events		∑ 3 events		3	
Scenario (C-D-I)	(m^3 ha^{-1})	(%)	(%)	rank	(m^3 ha^{-1})	rank	(m^3 ha^{-1} yr^{-1})	rank	*G*	rank
C25-D35-I04	19.1 ± 0.8	79	81	4	48.9 ± 2.0	6	0.65 ± 0.03	3	30.4	2
C25-D35-I08	32.5 ± 1.3	76	71	5	79.8 ± 3.7	4	1.06 ± 0.05	2	81.5	5
C25-D35-I12	43.7 ± 2.2	69	55	6	95 ± 6.3	2	1.27 ± 0.08	1	135.4	6
C60-D35-I04	18.8 ± 0.7	95	101	1	55.3 ± 1.6	5	0.31 ± 0.01	6	9.9	1
C60-D35-I08	32.3 ± 1.3	98	89	2	91.9 ± 3.2	3	0.51 ± 0.02	5	31.4	3
C60-D35-I12	43.2 ± 1.9	90	70	3	112.4 ± 4.8	1	0.62 ± 0.03	4	55.4	4

Conclusions

- In Guyana, the current statutory limit for felling cycle is too short for sustainable forest management.
- Only harvest intensities ≤ 4 trees ha^{-1} in combination with felling cycles ≥ 60 years will result in sustained timber yields.
- Because of the long time needed for recovery, logging an area of forest only once with relatively high harvest intensities should be considered.
- Results from this study have been applied to improve logging prescriptions in Guyana


Stump in selectively logged forest


Logs being transported to the saw-mill

Setting priorities

Alterra, Centre for Ecosystem Studies
P.O. Box 47
6700 AA Wageningen

eric.arets@wur.nl

Funded by the EC
(B7-6201/98-13/FOR)

Research carried out while working for:

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